A RAPID METHOD FOR PROPAGATING GRAPEVINES ON ROOTSTOCKS

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CONTENTS

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A RAPID METHOD FOR PROPAGATING GRAPEVINES ON ROOTSTOCKS

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INTRODUCTION

A need has existed for a simple and inexpensive way to propagate grapevines on rootstocks. Nurserymen should be able to furnish growers with grafted or budded plants, as is done with other fruits. At present, most grape growers field bud or graft growing rootstocks in vineyards. A great deal of labor and expense is involved. It is often 4 or 5 years before all rootstocks in a vineyard are finally budded or grafted successfully.

Vinifera vines on their own roots are not resistant to the serious root pests, rootknot nematodes, and phylloxera. Certain rootstocks derived from native American grapes carry resistance to rootknot nematodes, phylloxera, or to both pests. Rootknot nematodes are more serious on light sandy soils, and phylloxera are more active on roots in heavier soils. Intermediate soil types may present both nematode and phylloxera problems, though perhaps not as serious as with the extreme soil types.

Many growers choose not to use rootstocks in their vineyards because of the expense and trouble involved in propagation. As a result, fruit production and quality may be reduced because of root damage and lowered vine vigor. Only by making vineyard propagation on rootstocks simple and inexpensive can the full potential and value of rootstocks be realized in the grape industry.

At the U.S. Horticultural Field Station, Fresno, Calif., a procedure for propagating grapes on rootstocks has been developed which has given good results (fig. 1). It has been used since 1966 and has been described in a preliminary way[2/]. The details of the method are not new, but the combination of techniques and innovations is responsible for the success attained. European workers have developed similar methods as summarized by Becker[3/].

The steps involved in the procedure are as follows:

1. Making the bench graft
   a. Disbudding and making the rootstock
   b. Making the scion
   c. Fitting and stapling the union
2. Callusing the graft
3. Waxing the scion and union
4. Planting the graft in tubes
5. Growing the graft under controlled conditions
6. Transplanting the graft to the vineyard

MAKING THE BENCH GRAFT

A bench graft is simply a type of graft which is made on a bench or indoors rather than in the field. In this type of graft a scion is united with a rootstock cutting or rooting. The less expensive cutting is generally preferred with grapes. Almost any type of cut is satisfactory for making the union if the scion and rootstock pieces fit well. The type of cut may be whip and tongue, V-notch, double notch, tongue and groove, or some other type.

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2/ Loomis, N. H. and Weinberger, J. H., Better Grafting Techniques Produce Grapevines Faster. Western Fruit Grower 25 (3): 29-30, 1971.

3/ Becker, H., Aspects Modernes des Techniques de Conservation des Boutres et des Plants et de Production des Greffes-soudes. Office Int. Vigne Vin Bull 449(481): 223-237,1971.

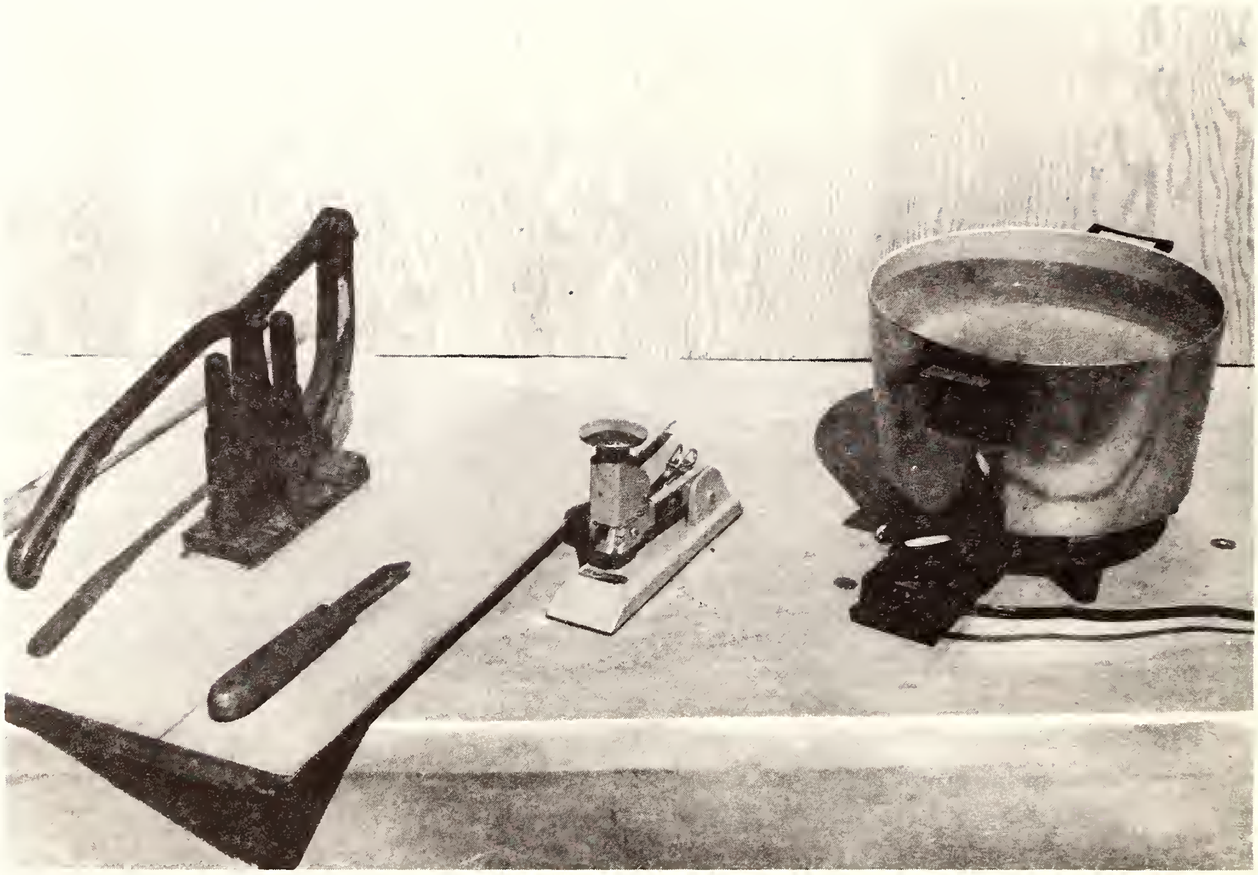

Figure 1. — Tools used in bench grafting procedure. From left to right: grafting machine, disbudding knife, desk stapler, paraffin heater.

The first step is to disbud the rootstock. The entire bud must be removed at each node and a deep cut is necessary to remove all the latent buds in the bark at the base of the bud. Ordinary hand pruning shears are effective in cutting off buds. Strong knives work well with small wood. A rotary rasp, or a wire wheel brush mounted on an electric bench grinder makes disbudding easy. The heavy wires readily gouge out the entire bud. The brush is self-cleaning, easily sharpened with an emery wheel, and the direction of turning can be reversed as the wires become bent backwards. All buds should be removed on the rootstock or suckering will be a problem in the vineyard.

The length of the rootstock cutting will depend on the distance the grower wishes to have the union above the ground line. Undesirable scion roots may form if the union is covered with soil by ridging in the vineyard row. Usually a union 6 inches above ground level is adequate. The rootstock cutting should then be 12 to 14 inches long, which would allow 4 inches of the rootstock in the tube, 6 to 8 inches above ground, and 2 inches to make the grafting cut.

The basal cut on the rootstock is usually made just below a node for rootstocks difficult to root may benefit from having a node at the base of the cutting for root initiation. With rootstocks which root readily, the basal cut can be made at any position on the cane with equal success, and not necessarily just below a node.

The top cut on the rootstock should allow at least 2 inches of straight internode section in which the graft cut can be made. The graft cut can be made through a node with equally good results if necessary. It is more difficult to make a cut, fit the union, and staple the union directly on the node.

Rootstocks differ greatly in the rate of rooting and rapidity of callusing. The success of the grafting depends on three developments: the growth of the bud, the knitting of the union, and the initiation of roots. If any one fails, the graft will die. Consequently, those rootstocks like Harmony, which root and callus rapidly, have an advantage over those like AxR No. 1 (Aramon X Rupestris Ganzin No. 1) and Ramsey (Salt Creek), which callus and root slowly. Grafts on easily rooted stocks will withstand much more neglect and mistreatment during their development and still be successful than those on slower rooting stocks. Every precaution should be taken to handle the latter type rootstocks in the best manner to assure successful take of the grafts.

All scion varieties tried have grafted successfully. Some varieties seem to take more rapidly than others.

Only one bud is necessary on the scion. Scion length may vary from one-half inch up. Two- to 3-inch scions seem to start growth faster than shorter scions, though length did not affect the final survival. Longer scions were of no benefit. The scion should be cut just above the bud. A straight piece of cane is needed below the bud in which to make the graft cut. It is not necessary to line up the bud with any particular part of the cut.

The scion and rootstock should be of nearly the same diameter if possible. However, good results may be obtained when their sizes differ if the cambiums are matched on only one side of the union.

The graft cuts may be made by hand with a knife, but usually a grafting machine either with fixed knife blades or with revolving saws is used. Both are equally successful if a good fit is obtained. The knife-type machines are mostly French-made, but obtainable in this country. A useful type makes a V-shaped cut with two knives. The scion is cut to a V point by inserting it in one side of the machine. The rootstock is V-notched by inserting it from the other side. The two fit perfectly when of equal diameter (fig. 2). Three sizes of knives are available with the

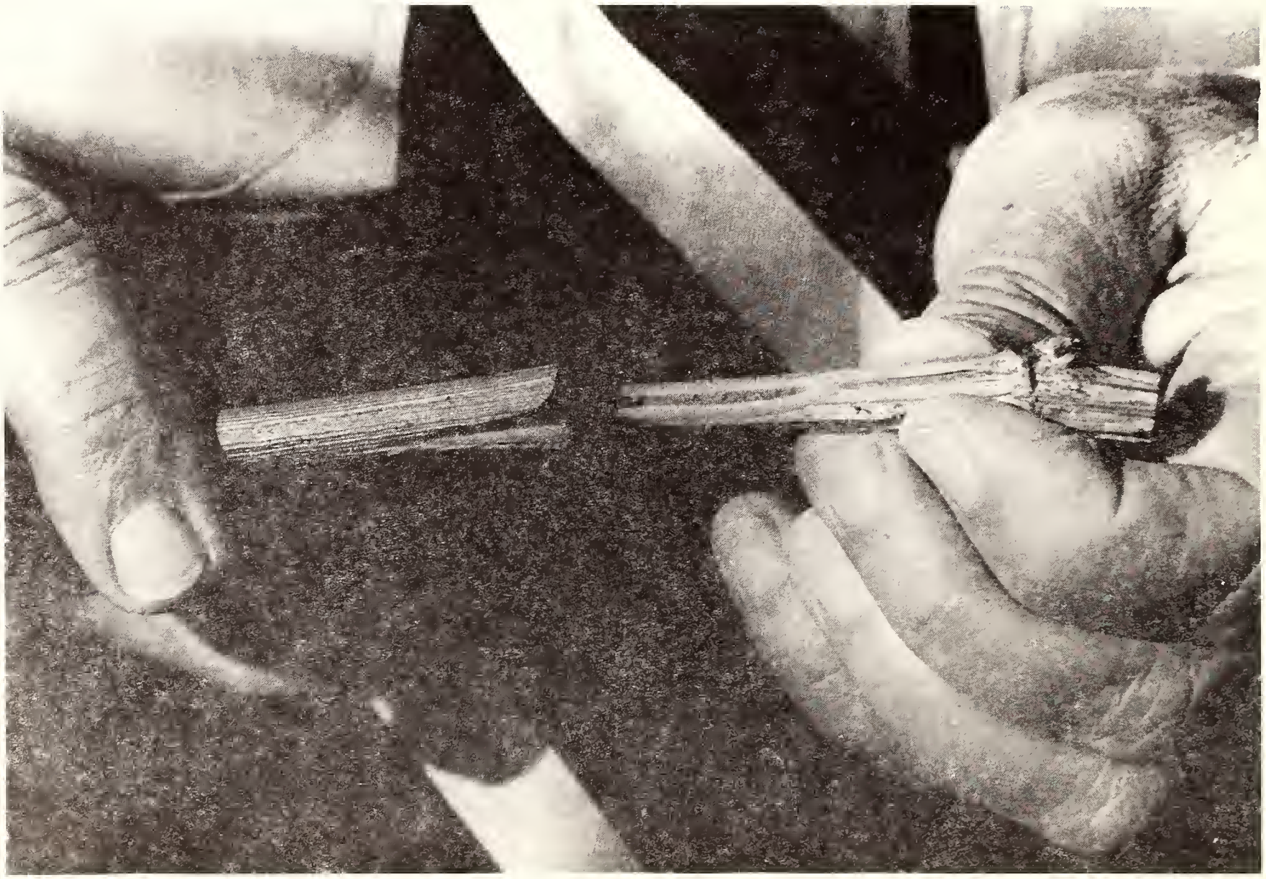

Figure 2. — Fitting the graft.

intermediate 30-millimeter size having more general applicability. Other machines with knives positioned differently are available also. Several machines automatically combine scion and rootstock.

Saw-type machines are generally made by mounting small circular saw blades on a shaft with spacers between them the exact width of the saw cut. Scion and rootstock cuts made with this type machine interlock. Another type makes a single large notch in the rootstock with a circular saw or a cutting tool mounted on a shaft. A tongued scion is cut to fit the notch. The saw machines are perhaps the most rapid, but cannot be used on small cuttings. The knife-type machines can be used with any size material, but work best with small and medium-sized wood. Small cuttings can be grafted successfully. Two hundred twenty six grafts made with Harmony cuttings, 15/100- to 1/4-inch diameter, resulted in 97 percent survival.

As the scions are made, they are dropped in water to keep them moist. Sorting them into large, medium, and small sizes at this time makes it easier to select a scion to match a particular diameter rootstock.

A reasonably close fitting of scion and rootstock is not difficult. The union is then fastened with an ordinary paper stapler. Different length staples are used depending on the diameter of the rootstock. The staple should penetrate through the rootstock and clinch slightly on the opposite side (fig. 3). A short staple which merely penetrates into the pith has no holding power. One-quarter-, 3/8-, and 1/2-inch staples cover the range needed for most grafts. Stapling the union is more rapid than tying. Ties must be cut later, whereas the staple is not removed and does no harm. Stapling also provides a maximum exposure of the union to the air which aids callusing.

CALLUSING THE GRAFT

Callus is the white healing tissue which forms rapidly on wounds on grape canes under warm, moist conditions. It forms slowly if at all at temperatures below 70 degrees F. Callus is necessary in grafts to form a living contact between rootstock and scion to furnish a passage for water to the scion after the graft is planted. Callus is not necessary for rooting but the same conditions which favor callusing also favor root development.

Warm temperatures of 75 degrees to 85 degrees F. and close to 100 percent humidity are best for callusing. Humidity is readily obtained by packing the grafts in moist, but not soggy, peat moss, vermiculite, perlite, or pine wood chips. The latter have advantages over other materials, of rapid soaking, and rapid drainage.

Tests with Harmony rootstock and Thompson Seedless scions showed that the grafts may be made any time during the winter and stored in a cool place until ready to plant in March. Grafts made December 3 had 89 percent survival; January 3, 80 percent; February 2, 87 percent; and March 2, 95 percent. Those grafts stored at 34 degrees had 82 percent survival. Those stored outdoors in shade had 93 percent success.

Those grafts which were callused immediately after grafting and then stored a month or more until planted had 83 percent survival. Those which were stored in a cool place after grafting and then callused immediately before planting had 92 percent success. It appears best to delay the callusing of grafts which are to be stored until just before planting. Growth processes started in callusing can then proceed without interruption. Chilling of grafts after callusing delays starting of growth. No fungicide was used during these tests, but with certain wood sources, a fungicide may be helpful.

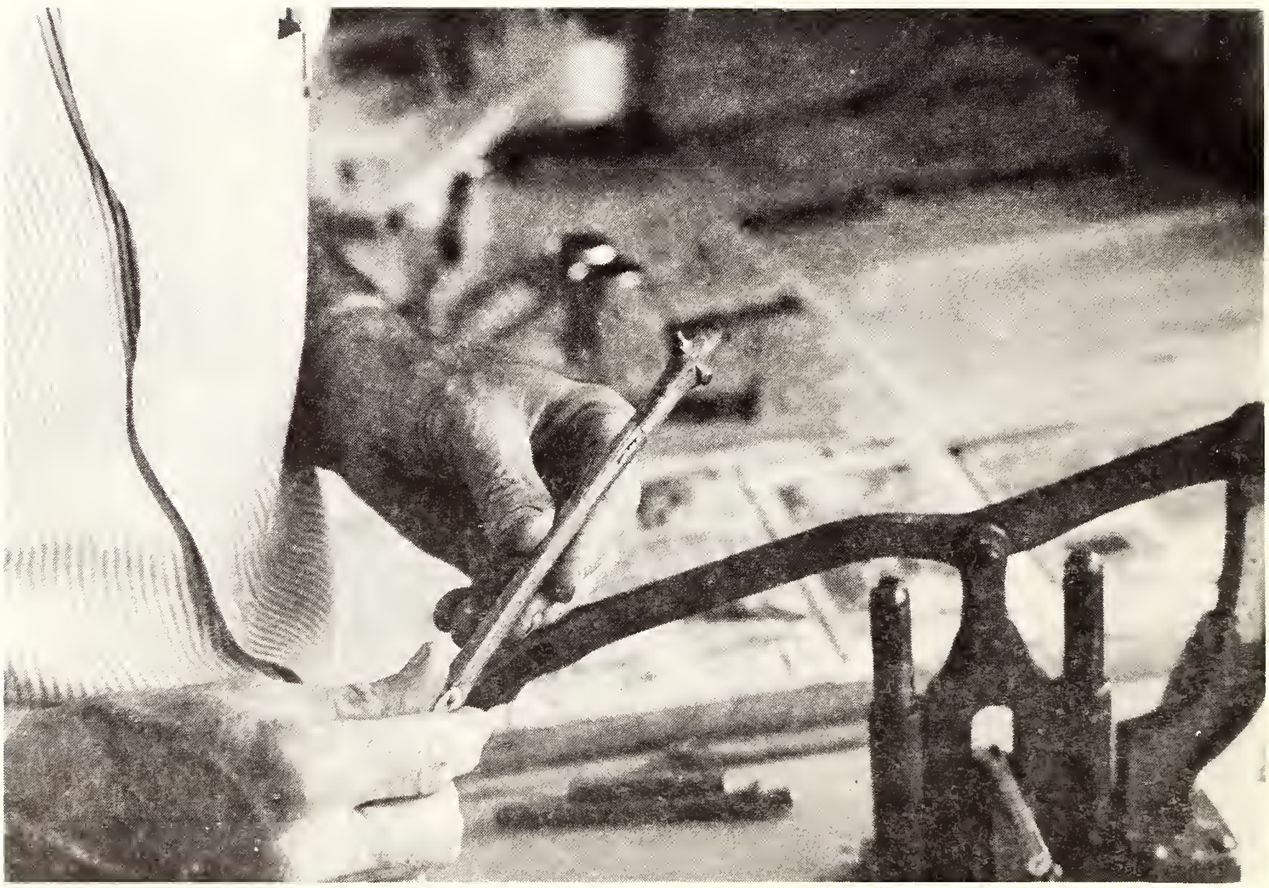

Figure 3. — Stapled graft ready for callusing.

Storing grafts outdoors in a cool place gave better results than storing under refrigeration. Grafts should be packed as for callusing in moist peat moss or pine sawdust to prevent their drying out. Do not use redwood sawdust. Grafts can be packed in a polyethylene bag or in a box lined with polyethylene to prevent moisture loss.

It is most important that the container in which the grafts are held for storage or for callusing should not be airtight. Oxygen is necessary for callus formation and to keep the grafts alive. Packing in deep containers can prevent oxygen from reaching the bottom of the container and may result in graft failure. Too much watering can also cut down on oxygen absorption and will prevent callusing. Shallow boxes such as lettuce crates with ample ventilation make easily handled containers. Drainage for excess water should be provided.

The grafts may also be callused in air without any packing material if the humidity is very carefully controlled at close to 100 percent.

Two to 3 weeks' time is adequate for callusing, depending on the temperature and the callusing rate of the particular rootstock.

As soon as the union is well covered with callus, the grafts should be removed from callusing. Lengthy exposure to high temperatures exhausts the reserve food supply in the grafts. Excessive bud and root growth should be avoided. The next step is to provide light to green up the bud growth and a rooting media in which the roots can develop and function.

WAXING THE SCION AND UNION

It is important to keep the grafts moist during handling. To prevent moisture loss from the scion while the bud develops and the union knits, the scion and union are washed free of loose particles of callusing media, and are dipped in ordinary low melting point paraffin at temperatures just above the melting point. New growth will not be injured, and should be left intact if possible. A second dip after cooling increases the paraffin load and reduces moisture loss appreciably. Other types of waxes having low melting points would probably be satisfactory. Waxing is very important for it is practically impossible to keep the scion alive after planting without this protection. By keeping the protected scion exposed to air the problem of scion root formation is avoided. The wax if too hot will coat only slightly, and may also injure the bud. Too heavy a wax coating may occasionally interfere with, or delay bud development. Commercial French fry cookers with thermostatic controls make excellent wax heaters.

PLANTING THE GRAFT IN TUBES

After callusing the buds are in a physiological condition for growth and need a growing environment. Almost any good potting mixture or sandy loam soil is adequate for root development. A satisfactory, lightweight mixture is one-third soil, one-third peat, and one-third perlite.

The planting tube can be made out of 15-pound roofing paper cut in rectangles 6 by 7 inches, curled into a tube 6 inches high and 2 inches in diameter, and stapled. Various inexpensive types of tubes made of milk carton paper or plastic impregnated papers are available commercially. All are equally good if they will last 3 months or more. A tube 6 inches high is deep enough for most grafts, but a 7-inch tube may be preferred for very long grafts. In cross-section a 2- by 2-inch tube is large enough for root development. A smaller diameter tube is not advisable for the grafts will be too crowded for good leaf development. Shading of the foliage becomes a problem with less than 4 square inches of surface per graft.

The grafts should be planted with the basal ends 2 or 3 inches from the bottom of the tube to allow room for root development. Few roots develop in the soil above the base of the cutting. Roots already formed on the grafts should be cut back to a length of one inch to avoid entangle-

ment in the tube. With rapid-rooting rootstocks, all roots can be brushed off at planting time without harm, but with rootstocks difficult to root attempts should be made to preserve the roots formed during callusing.

GROWING THE GRAFT

The most critical period in the life of the grafts is the few weeks after planting. Light, temperature, and humidity must be controlled.

While callusing, grafts are usually in complete darkness. Exposing the tender bud growth and callus tissue formed in darkness to full sunlight would damage them quickly. Also, callus tissue can dry out rapidly. After a few days of exposure to partial sunlight, the new growth toughens and acquires chlorophyll. The callus will continue to enlarge as the union knits.

A greenhouse or polyethylene house covered with a layer of 70 to 75 percent shade cloth will provide adequate light for 2 to 3 weeks and make humidity control easier. A single layer of 50 percent shade cloth is adequate if the grafts are covered with newspaper, cheesecloth, or burlap for the first few days. Shade protection of the scions from direct radiant heat of the sun is very necessary for graft survival. Seventy percent shade and 30 percent light will result in normal growth. As the grafts develop good tops and roots, light should be increased.

Temperatures for growing grafts are not critical, but a minimum of 70 degrees F, should be maintained to encourage root development. Easily rooted rootstocks will succeed without artificial heating in late spring. Slow-rooting rootstocks definitely benefit from 70 degree heating. Bottom heat is not essential if flats are on slats above ground level to provide air circulation. Maximum temperatures may go to 95 degrees or 100 degrees F. during the day without harm if humidity is also high. Grapes thrive in warm conditions.

Whether the tubes are in flats or on a bench, ample drainage for the rooting media is necessary for good root development. The use of tubes poses a special drainage problem.

Humidity must be maintained at a high level to prevent the grafts from drying out before roots develop. Grafts can pick up moisture from the humid air if needed. Without shade and high humidity, moisture stress on the scion may result in failure even though protected by wax. Humidity should not go below 70 percent. This can be maintained with evaporative cooling systems or by mist nozzles controlled by a humidistat. The air should feel "muggy". Excessive mist must be avoided as the soil may become too wet for root development. It can also harm foliage growth. Frequently, buds will start growing on the grafts before roots develop. Then for a few days or even weeks, growth practically ceases until roots are initiated. When the latter occurs, leaf growth accelerates rapidly.

With easily rooted rootstocks, bud and root growth are initiated almost simultaneously. With slow-rooting rootstocks, bud growth may be weeks ahead of root growth, so humidity control is very essential for survival. Without it a single, short, dry period could kill most of the grafts not yet rooted. Given proper conditions, even slow-rooting rootstocks will eventually initiate roots. The problem is to keep the graft alive until active roots develop.

The figure 70 is a convenient one to remember for initial growth conditions for grafts. Minimums of 70 percent shade, 70 degrees F. temperature and 70 percent humidity are handy guides. When roots show at the bottom of the tubes, humidity can be decreased, light exposure increased, and heating discontinued except for frost protection. Growth will then become hardened off when given full sunlight and wind exposure, preparatory to planting in the vineyard (fig. 4). Any graft which has live foliage on top and strong roots coming out the bottom of the tube is ready for transplanting.

Figure 4. — Flat of Thompson Seedless grafts ready for field planting.

Rooting hormones hasten root development on the slow-rooting rootstocks, but tests have not shown any benefit in survival of grafts. In a test with AxR No. 1, only 1 out of 51 grafts failed to root, with or without hormone application. Under certain situations, the use of hormones might be helpful.

TRANSPLANTING THE GRAFT TO THE VINEYARD

The secret of success in transplanting is the proper hardening off of the grafts and the undisturbed mass of soil and roots in the tube. The loss of grafts in transplanting should be negligible because the plant is little disturbed. If the root system is broken up and the graft is essentially bare-rooted in planting, high mortality can be expected.

Tests have shown that it is not necessary for survival of the plant to remove the tube in transplanting. The entire tube can be buried in soil and water applied over the top of the tube. Roots will emerge through the bottom of the tube. Full contact with the soil can be obtained by sliding the tube up 2 or 3 inches after the graft is set in the ground. An alternative would be the use of perforated tubes, which would allow the roots to escape through the sides. The frequency of irrigations will depend on weather conditions, but the plants should not be stressed. The root system is very limited during the first few weeks.

Field planting can be done any time after danger of frost is past. Early planting is very desirable for transplanting is less of a shock in cooler weather. Also, it provides a longer growing season and results in larger vines the first year. If any graft should fail in transplanting, it can be replaced at any time from a reserve supply of grafts. A grower should end up with 100 percent grafted vineyard in the fall of the first season.

The entire procedure from grafting to planting takes about 2 to 2-1/2 months, again depending on temperatures and the particular rootstock. If May 1 planting is planned, grafts should be started in callusing in late February, callused for 2 to 3 weeks, grown under protection for 4 to 6 weeks, and hardened off for at least one week.

The costs of the bench grafting method are much lower than those for field budding or grafting. Starting with canes, one man can make and prepare for callusing 300 to 600 grafts in an 8-hour day. Skilled labor is not necessary. With additional cost for planting in tubes and care of grafts under controlled conditions, the actual cost per graft may go as high as 15¢. The cost per successful graft will depend on percentage survival.

The principal innovations of the method are the quick stapling of the unions as a substitute for tying, the waxing of the graft unions to permit planting with the union exposed above ground to prevent the production of scion roots, and the use of planting tubes to ensure a high percentage of started grafts under favorable, controlled conditions, and to facilitate transplanting. The controlled conditions under which the grafts are grown after callusing are the principal reasons for better survival of grafts compared with the usual nursery practices. The method also offers the advantage of saving space. It is advisable to gain experience with small numbers of grafts before attempting large-scale operations.